DESCRIPTION

A DUCT CONNECTION ASSEMBLE BETWEEN A BRANCH DUCT AND A MAIN DUCT

The invention is a continuation-in-part Application derived from U.S. Patent Application No. 10/297,400 (International Application Filing Date: June 8, 2000 (PCT/JP00/03742)).

FIELD OF THE INVENTION

The invention relates to a duct connection assemble provided between a branch duct and a main duct in an improved way to prevent a water leakage seeping through therebetween.

BACKGROUND OF THE INVENTION

This type of the connection assemble is disclosed by Laid-open Japanese Patent Application No. 7-119884 by way of illustration in which a duct assemble introduces domestic waste water to run into a main ribbed duct. The main duct has an array of ribs around its securement opening. A branch duct has a saddle flange which has undulating wavy portions. Upon putting the branch duct on the main duct for connection, the undulating wavy portions interfit into the ribs of the main duct. At this time, an adhesive agent may be applied to the connection portion between the saddle flange and the main duct. The saddle flange may be tightly bound to the main duct by

means of a wire band. Otherwise, the saddle flange is tightly secured to the main duct by engaging a pawl against an inner wall of the main duct.

However, both the main duct and the saddle flange are formed by a hard synthetic resin material, and the saddle flange may slide against the main duct if they are shaken when subjected to an exterior force. In addition, the adhesive agent may deteriorate to fall off the saddle flange. This would result in the water leakage at the connection between the saddle flange and the main duct. This is all the more prone to the water leakage because the adhesive agent is not per se suited to a water sealing action.

Therefore, the present invention has been made with the above drawbacks in mind, it is an object of the invention to provide a duct connection assemble which is capable of positively sealing a connection between a main duct and a saddle flange to prevent a water leakage for an extended period of time with a relatively simple structure.

SUMMARY OF THE INVENTION

According to the invention, there is provided a duct connection assemble between a branch duct and a main duct, whereby upon connecting a saddle flange of the joint duct to the main ribbed duct through the communication hole, the rubber sealant is interposed between the saddle flange and a circumferential area of the communication hole so that protuberances uniformly

press the rubber sealant substantially through the recesses to tightly engage the saddle flange against an outer surface of the main ribbed duct through rib-fitting grooves and water sealing small projective rings.

In this instance, the rubber sealant elastically engages against the main ribbed duct and saddle flange to effectively absorb shaking tremor and impact so as to continuously water-tightly seal at an interface between the main ribbed duct and the saddle flange for an extended period of time. Due to the water sealing small projective rings provided on an inner side of the rubber sealant, the water sealing effect is significantly strengthened around a circumferential area of the communication hole. Due to the fact that the protuberances uniformly press the rubber sealant, the protuberances are forced into the recesses of the rubber sealant to expand the rubber sealant to elastically engage it with the main ribbed duct.

A rubber seal ring is provided to liquid-tightly seal between the saddle flange and a circumferential area of the communication hole, and the rubber seal ring is formed in one piece with the rubber sealant. Due to the rubber seal ring formed in one piece with the rubber sealant, the number of component parts is reduced to save the manufacturing cost, while at the same time, becoming facile to handle the rubber sealant to enable working staffs to quickly connecting the branch duct to the main ribbed duct.

A pawl stopper is rotationally supported on an inner wall of the branch duct in which the pawl stopper has a hook portion which engages with an inner edge of the communication hole. Due to the pawl stopper which rotates the hook portion to engage it with the inner edge of the communication hole, a connection structure between the main ribbed duct and the saddle flange is strengthened.

The rubber sealant is made of an water-expandable rubber. An elastic engagement against both the main ribbed duct and the saddle flange is strengthened to secure an effective water sealing action.

An inner surface of the recesses of the rubber sealant is tapered to progressively increases a breadth toward an outer periphery of the recesses. The tapered recesses serve as guides to readily fit the protuberances into the recesses.

A breadth of the protuberances is slightly greater than that of the recesses so that the protuberances elastically expand the recesses when fitting the protuberances into the recesses. Due to the recesses elastically expanded, an elastic engagement of the saddle flange against the main ribbed duct is all the more equalized.

The water-expandable rubber is formed by mixing an water-absorptive resin with styrene butadiene rubber (SBR) and isoprene rubbner (IR), otherwise prepared by mixing an water-absorptive resin with chloroprene rubber (CR).

The rubber sealant is in the form of rectangular frame which has a rectangular communication hole at an outer peripheral area of the rubber sealant.

The rib-fitting grooves are 2 to 3 mm in breadth, and the water sealing small projective rings are 1 to 3 mm in both breadth and height.

A plurality of small ribs are formed between the ribs, the rib-fitting grooves having narrow and deep grooves fit into the ribs and grooves of small depth fit into the small grooves.

A wire band is provided to tightly bind the saddle flange to the main ribbed duct.

According to the invention, there is provided a duct connection assemble in which a branch duct is connected to a joint duct which has a saddle flange formed on a lower portion of said joint duct. A main duct has an upper opening in correspondence to the joint duct. A rubber sealant has a communication hole which is to be in communication with the upper opening of the main duct. A plastic stopper plate has substantially an L-shaped cross section and is rotationally supported on an inner wall of the branch duct. The stopper plate has a hook portion which engages through the rubber sealant with an inner edge located around the upper opening of the main duct. Upon connecting the branch duct through the joint duct and the rubber sealant to the main duct, the stopper plate is rotationally moved so that the stopper plate tightly

engages the hook portion with an inner edge located around the upper opening of the main duct in accompany with an elastic deformation of the hook portion in which the hook portion elastically expands outward to strengthen an engagement against the inner edge located around the upper opening of the main duct.

According to other aspect of the invention, a right-angled triangle piece is provided on both sides of the hook portion. The right-angled triangle piece forms an acute angle against a vertical wall of the stopper plate. Upon engaging the hook portion with an inner edge located around the upper opening of the main duct, the hook portion elastically deforms to tightly engage its hypotenuse portion with the inner edge around the upper opening for positively securing it against removal.

According to other aspect of the invention, the stopper plate has a hook portion warped downward to define a curved plane. The curved plane elastically deforms to tightly engage with the inner edge located around the upper opening of the main duct at the time of connecting the branch duct to the main duct.

According to other aspect of the invention, the hook portion has a stepped portion along a breadth direction to define a slantwise plane consecutively formed from a base plane. The slantwise plane is successively elevated toward a tip end of the hook portion. At the time of connecting the branch duct to the main duct, the hook

portion elastically engages the slantwise plane with the inner edge around the upper opening so as to strengthen the engagement action.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred forms of the present invention are illustrated in the accompanying drawings in which:

Fig. 1 is a perspective view of a rubber sealant according to a first embodiment of the invention;

Fig. 2 is a longitudinal cross sectional view of the rubber sealant;

Fig. 3 is a plan view showing an inner side of the rubber sealant;

Fig. 4 is a longitudinal cross sectional view showing the manner when a branch duct is connected to a main ribbed duct;

Fig. 5 is an exploded cross sectional view of the branch duct, the rubber sealant and the main ribbed duct;

Fig. 6 is a longitudinal cross sectional view of the rubber sealant when fitting protuberances into recesses;

Fig. 7 is a longitudinal cross sectional view showing the manner in which the branch duct is connected to the main ribbed duct in cooporation with a pawl stopper;

Fig. 8 is a plan view showing the manner upon connecting the branch duct to the main ribbed duct by means of a wire band;

Fig. 9 is a plan view of a modification form of the rubber sealant;

Fig. 10 is a longitudinal cross sectional view of the rubber sealant;

Fig. 11 is a perspective view of another modification form of the rubber sealant with which a rubber seal ring is formed in one piece;

Fig. 12 is an exploded perspective view mainly showing the branch duct, the rubber sealant and a main duct according to a second embodiment of the invention;

Fig. 13 is a perspective view of the branch duct but partially broken;

Fig. 14 is a side elevational view of a stopper plate but partially broken;

Fig. 15 is a longitudinal cross sectional view of a stopper plate which engages with a main duct;

Fig. 16 is a perspective view of a stopper plate according to a third embodiment of the invention;

Fig. 17 is a perspective view of a stopper plate according to a fourth embodiment of the invention;

Fig. 18 is a side elevational view of the stopper plate but partially broken; and

Fig. 19 is a side elevational view of a stopper plate according to a fifth embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring to Figs. 1 through 8 which show a first embodiment of the invention, a rubber sealant 1 has a rectangular contour and warped to have a radius

corresponding to that of a saddle flange 2a provided on a lower portion of a joint duct 2 as shown in Figs. 1 and 2. An inner surface of the rubber sealant 1 has streaks of narrow and long grooves 1a (e.g., 2 to 3 mm in width) with regular intervals (e.g., 3 to 8 ridges) along a main ribbed duct 3 so as to fit the grooves 1a to ribs 3a provided on the main ribbed duct 3 upon connecting the saddle flange 2a to the main ribbed duct 3.

Provided with a central area of the rubber sealant 1, is a communication hole 1b in correspondence to an upper opening 3b provided on the main ribbed duct 3 as shown in Fig. 3. Around periphery of the communication hole 1b, concentrically provided are streaks of water sealing small projective rings 1c (e.g., three ridges each 1 to 3 mm in breadth and height). Opposite to the side in which the grooves 1a are provided, bottomed recesses 1d (e.g.. four) are formed in the manner to position between the neighbouring ribs 3a and to surround the communication hole 1b.

In this instance, the recesses 1d are formed into a rectangular configuration, and inner surface of the recesses 1d is tapered to progressively increase its breadth toward an outer periphery of the recesses. The tapered recesses 1d serve as guides when receiving protuberances 2b provided on an inner surface of the saddle flange 2a. Depth and breadth of the recesses 1d are in correspondence to length and breadth of the

protuberances 2b. In the main ribbed duct 3 shown in Figs. 4 through 6, small ribs 3c are defined between the ribs 3a, grooves 1e of small depth are formed on the rubber sealant 1 in correspondence to small ribs 3c.

As shown in Fig. 7, a branch duct 2c is interfit into an inner wall of the joint duct 2, and an outer surface of the branch duct 2c has a male thread portion 4 to which a nut ring 6 is secured by means of a handle 5. Between a lower portion of the branch duct 2c and an inner edge of the upper opening 3b, interposed is a rubber seal ring 7.

With a lower edge 6a of the nut ring 6 engaged against an upper end of the joint duct 3, the nut ring 6 is turned in a predetermined direction to move the branch duct c downard to press the rubber seal ring 7 so as to liquid-tightly connect the branch duct 2c to a periphery of the upper opening 3b. A securement duct 8, which introduces the domestic waste water, is connected to the branch duct 2c via a rubber connector 2d. An L-shaped pawl stopper 9 is rotationally pivoted at an upper end to an inner wall of the branch duct 2c by means of a pin 10. The pawl stopper 9 has a lower hook portion 9a which engages with the inner edge of the communication hole 1b to serve as a duct locking means which strengthens the connection between the branch duct 2c and the main ribbed duct 3.

With the structure thus far described, the main

ribbed duct 3 is embedded within the ground as a sewer conduit, and the joint duct 2 is bring to the main ribbed duct 3 to connect the saddle flange 2a to the periphery of the upper opening 3b through the rubber sealant 1. In this instance, the grooves 1a fit to the ribs 3a of the main ribbed duct 3, and the water seal small projective rings 1c elastically engage with an outer surface of the main ribbed duct 3. In accompany with the protuberances 2b fit into the recesses 1d of the rubber sealant 1, the rubber sealant 1 is uniformly pressed against the main ribbed duct 3 to elastically connect the joint duct 2 and the main ribbed duct 3.

In this instance, a length of the protuberances 2b may be smaller than a depth of the recesses 1d, and a breadth of the protuberances 2b may be somewhat greater than that of the recesses 1d so as to elastically expand the recesses 1d upon fitting the protuberances 2b into the recesses 1d. With the result that the protuberances 2b are forced into the recesses 1d to press the rubber sealant 1 as a whole, thus enabling the workers to more uniform engagement force against the main ribbed duct 3.

The uniform engagement force is all the more strengthened with the use of the pawl stopper 9 which engages against the saddle flange 2a (see Fig. 7), and with the use of a wire band 11 bound around the saddle flange 2a and the main ribbed duct 3 (see Fig. 8). The rubber sealant 1 may be made of a water-expandable rubber

by mixing an water-absorptive resin with styrene butadiene rubber and isoprene rubbner, otherwise by mixing an water-absorptive resin with chloroprene rubber. With the water-expandable rubber applied to the rubber sealant 1, the rubber sealant 1 expands when immersed in the water to significantly improve the water sealing action.

Figs. 9 and 10 show a modification form of the rubber sealant 1. The reference numerals identical to Figs. 1 ~ 8 corresponds to the reference numerals in the modification form. The rubber sealant 1 is altered at geometrical shape based on an adaptability relationship betweeen the main ribbed duct 3 and the saddle flange 2a. In the case of the modification form, the communication hole 1b is relatively large. For this reason, the periphery of the rubber sealant 1 is defined into a frame-like configuration. Vertically opposed sides of the rubber sealant 1 is provided with the lateral recesses 1d, and horizontally opposed sides of the rubber sealant 1 is provided with the square recesses 1d (e.g., nine in each side) in an up-and-down direction.

Fig. 11 shows another modification form in which the rubber seal ring 7 of Fig. 7 is formed in one piece with the rubber sealant 1. This reduces the number of component parts to save the manufacturing cost, while at the same time, becoming facile to handle the rubber sealant 1 to enable the workers to quickly connecting the branch duct 2c to the main ribbed duct 3. Shapes of the

rib-fitting grooves 1a in Fig. 11 are different from those in Fig. 1 and the recesses 1d are omitted only for the purpose of convenience.

The ribs 3a may be tapered off toward a front end of the ribs 3a, and the rib-fitting grooves 1a may be flared toward an open end of the rib-fitting grooves 1a. This makes it possible to readily locate the ribs 3a in the rib-fitting grooves 1a, and tightly engage the ribs 3a with the rib-fitting grooves 1a to secure an elastically tight engagement between the ribs 3a and the rib-fitting grooves 1a. It is to be noted that the recesses 1d may be formed substantially into any geometrical shape such as semi-circular, circular, triangular, square or polygonal configuration.

Figs. 12 through 15 show a second embodiment of the invention in which the rubber sealant 1 is simply formed into an annular ring configuration to be attached to a ribless main duct 3A, and a pair of plastic stopper plates 20 is provided to position in diametrically opposed location.

The stopper plate 20 has substantially an L-shaped cross section so that the stopper plate 20 is located at a vertical recess 25 provided on an inner wall of the branch duct 2c. A hook portion 20a forms an acute angle (θ) (e. g., 80 degrees among an angular range of $0 < \theta \leqq 85$ °) against a vertical wall 20B of the stopper plate 20 as shown in Fig. 14. A pin 21 is provided on both upper

elevational sides of the stopper plate 20 in correspondence to a groove 22 formed on an upper open end of the branch duct 2c as a pin-and-groove combination. An L-shaped cavity 23 is provided on both sides of the vertical wall 20B of the stopper plate 20 in correspondence to a pin 24 formed on the inner wall of the branch duct 2c. The cavity 23 is paired at right and left side of the vertical wall 20B in two tiers in up-and-down direction.

The L-shaped cavity 23 has a lateral portion 23a and a vertical portion 23b. The lateral portion 23a extends along a thickness direction of the vertical wall 20B of the stopper plate 20, while the vertical portion 23b extends along a lengthwise direction of the vertical wall 20B.

The stopper plate 20 is adapted to vertically and rotationally move at the groove 22 when fitting the pin 21 into the groove 22 so that the pin 24 is admitted through a lateral portion 23a into the cavity 23.

Upon connecting the branch duct 2c to the main duct 3A through the annular rubber sealant 1 as shown in Fig. 15, the pin 21 located in the groove 22 is slightly moved downward so that the vertical portion 23b embraces the pin 24 which is previously admitted into the lateral portion 23a of the cavity 23 so as to prevent the stopper plate 20 from disengaging inadvertently from the inner wall of the branch duct 2c.

In accompany with rotationally moving the stopper plate 20, the stopper plate 20 tightly engages the hook portion 20a with an inner edge 3s located around the upper opening 3b of the main duct 3A in combination with an elastic deformation of the hook portion 20a. At this time, the hook portion 20a elastically expands outward to strengthen an engagement against the inner edge 3s circumferentially located around the upper opening 3b of the main duct 3A.

Fig. 16 shows a third embodiment of the invention in which a right-angled triangle piece 20c is provided at both sides of the hook portion 20a. A hypotenuse portion of the right-angled triangle piece 20c forms an acute angle ($0 < \theta \leqq 85^\circ$) against the vertical wall 20B of the stopper plate 20. At the time of engaging the hook portion 20a with the inner edge 3s located around the upper opening 3b of the main duct 3A, the hook portion 20a elastically deforms to tightly engage its hypotenuse portion with the inner edge 3s around the upper opening 3b for positively securing it against removal in the same manner as described at the second embodiment in Fig. 15.

Figs. 17 and 18 show a fourth embodiment of the invention in which the hook portion 20a is slightly warped downward to define a curved plane. A basal portion of the curved plane forms either an acute angle ($0 < \theta \leqq 85^\circ$) or a substantial right angle against the vertical wall 20B of the stopper plate 20.

Fig. 19 shows a fifth embodiment of the invention in which the hook portion 20a has a stepped portion 20f along a breadth direction to define a slantwise plane 20g consecutively formed from a base plane 20j. The slantwise plane 20g is successively elevated upward toward a tip end 20h of the hook portion 20a. At the time of connecting the branch duct 2c to the main duct 3A in the same manner as described at the second embodiment in Fig. 15, the hook portion 20a engages the slantwise plane 20g with the inner edge 3s around the upper opening 3b so as to strengthen the engagement action. In this instance, the base plane 20j forms either an acute angle ($0 < \theta \leqq 85^\circ$) or a substantial right angle against the vertical wall 20B of the stopper plate 20.

It is to be noted that a pair of the L-shaped cavities 23 is not confined to two areas in two tiers, but a pair of the L-shaped cavities 23 may be placed on a single one area or three more areas. The cavities 23 may be provided on the inner wall of the branch duct 2c, and the pin 24 may be provided on the vertical wall 20B of the stopper plate 20. It is to be appreciated that a wire band may be provided to tightly bind the saddle flange 2a to the main duct 3A.